Memoir of Pliny Earle Chase. By Philip C. Garrett.

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Pliny Early Chase was a native of the old Puritan Commonwealth which has probably contributed more than any other to the intellectual life of this country. He was born at Worcester, Mass., on the 18th of August, 1820, and was descended on both sides from the hardy and intelligent yeomanry of New England, most of his ancestors in this country having been farmers. His father, Anthony Chase, was for thirty-four years Treasurer of the county of Worcester and for thirty years President of the Worcester Mutual Fire Insurance Co., and died as recently as 1879 at the advanced age of eighty-eight years. His mother was Lydia Earle, of the neighboring town of Leicester. Her father, Pliny Earle, "made the first cards ever propelled by mechanical power in America, and invented a machine by which the manufacture of them was greatly facilitated;" Dr. Pliny Earle, one of the most distinguished alienists of this country, was her brother; another was Thomas Earle, an eminent philanthropist, member of the Pennsylvania Constitutional Convention of 1837 and candidate of the Liberal Party for the Vice-Presidency in 1840; a third, John Milton Earle, was for many years Editor of the Massachusetts "Spy."

The subject of this Memoir was of the eighth generation in descent from Ralph Earle, who "was on the island of Rhode Island in 1638, was one of the petitioners to the King for permission for the formation of a 'body politic' on that island, and was subsequently a member of their legislative Assembly."

Pliny Earle Chase's early education was received at the Worcester Latin School, the principal of which, at that time, Hon. Charles Thurber, afterwards member of the Massachusetts Senate, preceded his distinguished pupil to the "Silent Land" only a few days. Ex-President John Adams had been a teacher in the same school. Pliny afterwards attended the Friends' School at Providence, R. I., and entered Harvard in 1835, graduating from that University in 1839 with the degree of A. B., and receiving that of A. M. in 1844. "As a boy, he was bright, intelligent, apt and quick in the acquisition of knowledge, but without special precocity. He was always one of the best scholars, but there was nothing that indicated the profundity of intellect manifested in his later years." In a letter to his uncle, he writes, in his Freshman year: "I am chiefly guided in the path which I intend to pursue by an aspiration after such honors as are calculated to be of lasting benefit in forming an acquaintance with the ways of the world and in acquiring *honorable fame.*"

He was then only fifteen years of age, but his career would indicate that he kept this honorable ambition of his boyhood constantly in view throughout life. Edward Everett Hale, who was a Harvard classmate, informs that he was "distinguished for scholarship, especially for mathematical scholar-

ship, in his class at Cambridge. He was one of a special advanced section in mathematics, of which no member had had to take a lesson a second time. They were therefore so much in advance of the great body of the class that, at the end of the mathematical course, they had the advantage of special instruction from Prof. Peirce in higher mathematics. He was interested in all branches of physics. I remember him especially," writes Mr. Hale, "as one of eight observers who made some of the first observations which are on record of the shooting stars. The record will be found in the 'American Journal of Science,' of 1837, and I believe of the 'Comptes Rendus' of the French Academy of the same year. He was a quiet, unobtrusive young man, but a favorite with the class from his uniform courtesy, and a rare sense of humor, which never left him through life." Upon taking his degree at Harvard, he immediately entered the pedagogic profession, at first in district schools in Leicester and Worcester, then in 1840–1 as Associate Teacher in the Boarding-school at Providence, in which he himself had prepared for College. In 1841–2 he taught at Friends' Select School on Cherry street, in Philadelphia, and, from 1842 to 1844, conducted a private school in the latter city. On the 28th of June, 1843, he married Elizabeth Brown Oliver, of Lynn, whose brother, Prof. James E. Oliver, of Cornell University, was a man of kindred tastes to his own. The following two years were spent in New England, where he prepared for publication his first book, the "Elements of Arithmetic, Parts I and II," afterwards published by Uriah Hunt & Sons, of Philadelphia. This was followed, in 1848, by "The Common School Arithmetic." In the course of 1850, in connection with Horace Mann, he prepared and published "Mann & Chase's Arithmetic, practically applied," remodeling the 1st and 2nd parts of the "Elements of Arithmetic" into a new series, which was published by E. H. Butler & Co., Philadelphia.

Dr. Thomas Hill, ex-President of Harvard University, bears the following testimony to the value of his arithmetical works: "Chase's Arithmetic was the best I ever saw. The two books 'Chase' and 'Chase & Mann,' as we called them, were worth all other arithmetics that I ever saw put together. When I first introduced 'Chase' into the public schools of Waltham, I had a hard battle with the committee and with the teachers. They thought it too difficult, etc., but, in less than one year, all were satisfied, and at the end of three years, all enthusiastic. No schools in Massachusetts, and I believe none in the world, equaled our Waltham schools in arithmetic. But the publishers sold the plates to a Boston firm, who had another and inferior book to push, and they melted up the plates of Chase, to my intense indignation." Stronger proof of their merit could scarcely be given. Dr. Hill regarded them not as compilations, such as the common run of arithmetics, but as original contributions to pedagogy, and "classed Mr. Chase not with mere compilers, but rather with the originators, whose work is more akin to Pestalozzi's, and who deserve to rank very high;" and probably no higher testimony could be produced than Dr. Hill's, on this point.

In the fall of 1845, Mr. Chase returned to Philadelphia and conducted a private school for girls, at the same time giving lessons in other schools and in families. In all probability, he would have continued uninterruptedly in the pursuit of that profession, in which he was beginning to earn a measure of the "honorable fame" to which he aspired in his boyhood, had not severe hæmorrhages of the lungs, occurring three years later and continuing, with diminishing frequency, for ten years, compelled him to relinquish teaching. His physicians recommended a life which would allow of more out-door air and exercise, and he entered into a manufacturing business, under the name of North, Harrison & Co.

Two years later, John Edgar Thomson, President of the Pennsylvania Railroad Company, joined the firm as special partner, and a younger brother of Mr. North as general partner, under the firm name of Norths, Harrison & Chase, who conducted a large foundry at Wilmington, Del., with sales-rooms in Philadelphia. In the following year, Mr. Harrison died, and the name was changed to North, Chase & North, and eventually Chase became the head of the firm of Chase, Sharpe & Thomson, the junior of which was Edgar L., a nephew of President Thomson. But although their house engaged in an extensive wholesale trade extending to foreign countries, the practical business element was somewhat deficient in the head of the house, who greatly preferred intellectual pursuits, and, after suffering heavy losses, he finally, in 1866, after having wasted eighteen precious years in uncongenial occupations, sold out his interest in the foundry business. He was at this time forty-six years of age. Prof. Chase has been criticised for too much diversification of pursuits. It was characteristic of this tendency, that for six or eight years prior to abandoning mercantile life, he had given private lessons in the then famous school for young ladies of Prof. Charles Dexter Cleveland; and five years earlier had actually bought the furniture and good-will of Prof. Cleveland, upon the latter's retirement from teaching. This course, while more to the taste of so intellectual a man, did not conduce to the success of the foundry business which he was conducting, and which afterwards, in the hands of a former employé, proved exceedingly profitable, although the closing years of Prof. Chase's connection were the lucrative years of inflation caused by the war of the Rebellion. In the very same year, he also gave up the finishing school for young ladies, his own impression being that "the breaking out of the war interfered with private schools." He did not, however, abandon teaching, and from this time until his death adhered to his chosen profession, pursuing it continuously, if we except two visits to Europe, on the first of which, in 1870, he accompanied a party of young ladies who had been his former pupils and who sought the benefit of his familiarity with the European languages, as well as his agreeable companionship. The second visit was made in the summer of 1883 with members of his own family.

His later days were certainly his best days as a teacher, and while a natural modesty stood in the way of ambition, and he preferred a quiet

and unobtrusive life, yet he attained a highly creditable standing in the profession. On the sixteenth of January, 1863, he was elected a member of the American Philosophical Society, to whose Transactions and Proceedings he afterwards became a diligent contributor. He occupied for a time the Chair at the University of Pennsylvania, rendered vacant by the death of Prof. Fraser, and, in 1871, became Professor of Natural Sciences in Haverford College, and remained a member of the faculty of that congenial institution until his death, occupying, after 1875, the Chair of Philosophy and Logic, then established. In 1876 he received the honorary degree of LL.D. from Haverford, on the ground of "his attainments and original researches in Mental and Physical Philosophy." Two years later, in the summer of 1878, after a severe illness, which resulted in the partial paralysis of one foot, and sensibly abated his physical vigor, he removed from Philadelphia to reside in the cottage on the beautiful grounds, in a bit of natural forest, adjoining the magnificent avenue of maples which forms the approach to Haverford College. On this charming spot, in the midst of sweet pastoral scenes, abounding in vegetable life, he had an excellent opportunity to indulge his taste for botany, a favorite pursuit. In 1884 he received the appointment of Lecturer on Psychology and Logic at Bryn Mawr College for Women. He prepared the syllabus and notes for the first course of lectures, which he was to have delivered in the winter of 1885-6, but was never able to deliver them, being overtaken by his final illness during that season. A sharp attack of pneumonia sapped the foundations of a vitality already much undermined, and although he partially recovered and resumed his duties at Haverford, the end was evidently drawing near. During the brief interval of life that remained and in consequence of the absence in Europe of his brother Thomas, who was President of Haverford College, he was made Acting President of that Institution, and held that position when death came, presiding at the Annual Commencement of 1886. His name had been prominently mentioned for the Presidency of Bryn Mawr College at the time of its organization, but the precarious state of his health forbade, although his eminent scholarship, the variety of his learning, and his previous experience in Young Ladies' Schools, strongly commended him for that position.

As a College Professor, he was clear in his demonstrations and attractive; and many are the testimonies of affection and respect borne by his former students, accompanied by acknowledgments of the important influence of his teachings upon their lives. As a disciplinarian, he was mild and easy, inspiring his pupils with love rather than fear; indeed the latter was not an ingredient in his system at all; he governed purely by gentle suasion.

Such is the simple record of a quiet life, the annals of which display no startling passages. If modesty were the opposite of greatness, then he was not great. But there was an unusual combination of great and good qualities in his mind and character, and one of its most conspicuous traits

was a rare simplicity, indeed genuine modesty and humility, which is oftenest closely allied to a true greatness in the soul, unconscious of itself and busied with lofty studies of omnipotent power and sublimity. It was through this beautiful quality, which was perfectly natural and unassuming, that he endeared himself much to all of his intellectual associates, whether pupils or companions of his own age.

He had a singularly versatile mind, and a comprehensive and richly furnished memory. His writings included a wide range of subjects, upon each of which he displayed much erudition, and they were full of suggestiveness. It is seldom that a like capacity is found in one mind, both as a linguist and as a mathematician. He read with the help of dictionaries, and was more or less familiar with one hundred and twenty-three languages and dialects, and claimed thorough acquaintance with thirty of them. His knowledge of these was not profound, nor was it marked by the accuracy, in pronunciation and otherwise, which familiar conversation requires. Yet his attainments as a linguist afford a remarkable indication of the scope of his mind and the extent of his memory, and therefore throw an important light upon our estimate of the value of his deeper and more characteristic productions. Occasional contributions to the Proceedings of the American Philosophical Society were made on subjects in Comparative Philology, as the paper "On Radical Etymology," that on the "Mathematical Probability of Accidental Linguistic Resemblances," on "Sanscrit and English Roots and Analogues," on the "Comparative Etymology of the Yoruba Language," and others. His reputation as an analyst was sufficient to induce the sending to him of an obscure cipher from the War Department for translation during the Rebellion, and, on another occasion, of a Coptic inscription. But although his philological attainments were in no wise mean, his pen was most fertile in other directions. Of over 150 papers contributed by him to various learned bodies, most of them to this Society, not more than one-tenth were philological, and the remainder mostly in meteorology, cosmics and physics. Many of these were fragmentary,—studies, as it were, of great themes,—and in undigested groups; they were unfinished, like Michael Angelo's marble groups, and needed the master's hand to give them the perfect expression intended. As he grew older, they took more and more a cosmical direction, and his mind struggled to demonstrate from the harmonies of the universe, as the geologist does from the marvelous narrative of the rocks, a cosmical evolution. Going back to the very sources of development with daring genius, he sought, through proofs of the "Quantitative equivalence of the different forms of force which we call light, heat, electricity, chemical affinity, and gravitation," and original theories of nodal accumulation, the truth of which time may affirm, to establish a common law that "All physical phenomena are due to an Omnipotent Power, acting in ways which may be represented by harmonic or cyclical undulations in an elastic medium." A peculiarity of his mental operations was a singular capacity for seeing harmonies and analogies

which did not attract the attention of others. His methods of thinking were swift, and led him to undemonstrated skips in his reasoning which made it difficult to follow him. In the ordinary processes of addition, he footed up columns of eight or ten numbers, extending into trillions, instantaneously, setting down the result from left to right, ending with the units. A certain instinctive or intuitive faculty pervaded his demonstrations, interrupting their purely mathematical character, and making many mathematicians and physicists plausibly skeptical as to the value of his theories.

An eminent scientist at one time spoke of him as "the Kepler of this century," and there was a certain resemblance, in the tentative methods pursued by him, to those by which his great prototype discovered the astronomical laws upon which his fame is based.

Prof. Kirkwood writes: "The just value of his contributions to science cannot at once be determined. It must be said, however, that his hypothetical conclusions were so often in close agreement with well-known facts, as to leave the impression that his theories must have a foundation in truth."

Prof. Herschell, referring to his paper on "The Results of Wave Interference," bears this testimony: "From a direction of research probably as distant and distinct as possible from the late Prof. Chase's, at least in its origin, I have reached results which the contents in this case, of Prof. Chase's papers, confirm and corroborate so amazingly, that all question of the real validity of views, however incongruous they may perhaps be to each other in particulars, by which identical results of such surprising characters have been arrived at by us both, in perfect independence, is banished completely and forever from my mind. Prof. Chase's writings and discoveries will constantly gain in note and consequence by wider and longer consideration and perusal; and they will surely never cease to have leading uses for consultation and for purposes of instructive study, among those who aim and strive to unmask more laws of energy's unitary operations, if possible as prominent and predominating as those which his discoveries have disclosed."

An American philosopher, who, while somewhat uncertain how to estimate him, says he is hopeful that the future will reveal the value of Prof. Chase's labors, speaks thus of his later work: "It may prove prophetic of developments that will take us a long step below our present philosophy of things—or it may not. Time will show. If the new developments do come, my feeling is, that they will help to bring the heavens and the earth nearer together, by showing that beneath the seemingly ultimate facts of matter, gravitation, conservation of work, things that may seem to pertain to no other life of ours than this—that beneath these, and nearer to the ultimate reality, there lies an order of things that may well serve as the physical basis of this and the next life alike."

Prof. Chase, although, as we have already said, very modest in his esti-

mates of himself, was confident that his conclusions pointed in the right direction. Yet he did not claim mathematical demonstration for his theories, and while his papers abounded in formulæ, they were only partly mathematical even in form. There was an element of imagination, of speculation and of intuition. The harmonies are not always perfect, links are missing ; very probably some of them will prove to be accidental, while others, with their profound inductions, will remain firmly planted upon the rock of truth. Indeed, they have claims, not only to coincidence with the conclusions of other philosophers, derived from different data, and reached through other channels, but even to verification as predictions. Dr. Chase regarded the series of twelve papers contributed to the London, Edinboro' and Dublin Philosophical Magazine as containing, to quote his own words, some of his "most important discoveries in confirmation of the nebular hypothesis, including nine verifications of intra-mercurial planets and of harmonies of solar and planetary rotation that he had predicted some years prior to the discovery." These "verifications of intra-mercurial planets" should rather be designated "Confirmations from other sources of his opinion predicting them." These special articles comprised the 1. Cosmical Activity of Light ; 2. Equilibrating Forces of the Solar System ; 3. Planetary Interaction ; 4. Our Binary Star and its Attendants ; 5. Correlations of Central Force ; 6. Ætherial Nodes ; 7. Momentum and Vis viva ; 8. Undulation ; 9. Criteria ; 10. Radiation ; 11. Watson's Intra-mercurial Planet ; and, 12. Predictions. The titles of these papers sufficiently indicate their character and his claims of original discovery, which are further elucidated by such others, appearing elsewhere, as "The Gamut of Light," "The Music of the Spheres," "The Beginning of Development," "Planeto-taxis," and "Photo-dynamic Notes." Regarding light as the primal manifestation of force, and the Almighty fiat, "Let there be light" as the order for movement in the cosmic element, out of which all the complex development of the universe has grown, he felt after and sought to discover the fundamental laws whose universal application might pervasively explain all material forms and forces. Thus his investigations were not limited to the relations of the great forces of light, gravity, electricity, etc., but his speculations on the harmonies extended to the laws which govern chemical affinity and to ordinary material things. This much may be said as to these investigations : that

1. Whatever may be the ultimate conclusions of Science as to the precise nature and extent of the evolution, there has been an evolution from the simpler and more comprehensive conditions of matter, into the more complex and multiform.

2. It is reasonable to suppose that this entire evolution has been in accordance with some general law.

3. The discovery of that law is probably within the reach of the human mind.

It was after this law that Prof. Chase was searching ; the character of his

mind was one that eminently fitted it for the investigation; and future researches may show his work to have been founded in fact and correct inference, and that he was in advance of his age and above the heads of his critics. The respect in which his writings have been held in Great Britain has been attested by their publication in the "Philosophical Magazine." His essay on "The Numerical Relation between Gravity and Magnetism" received, in 1864, the Magellanic Premium from this Society.

The detached and fragmentary character of his scientific productions, their real profundity, and the limited number of those who could follow him in his rapid evolution of thought on these subjects, have led many scientific men to regard his speculations with doubt, and some, who had little or no personal acquaintance with their author, accord them no scientific value. But Prof. Chase was least of all a hypocrite or a charlatan, and those who knew him best will most unhesitatingly recognize his deep sincerity. He was an humble seeker after truth, with the lamp of a strong intellect. The obscurity of his logic belongs not altogether to the writer, but to his theme. There was nothing obscure about his ordinary style. When he wrote upon familiar topics it was clear and cogent, rising sometimes into flights of eloquence. It is to be regretted that he has not himself been able to put into compact and comprehensible form his studies on cosmical and molecular forces as applied to astronomical and interplanetary relations, and no less the profound, though fragmentary notes, which his mind threw off in later scintillations. But they were not completed, and though much more than gropings after the facts of infinity, can not lay claim to perfect and final demonstration. Whatever title his name has to rank among the greatest on the rolls of science, however, no one who knew his work will deny him an eminent place.

The loftiness of conception and inspiring suggestiveness of his writings, his extensive learning, his great industry and productiveness, his boldness and success in dealing with the problems of the unknown world, entitle him to distinction. Aside from his deeper and favorite themes, the range of subjects ably treated by his pen was notable. Among these may be remarked such familiar topics as Bricks, Paper, Ink, Ceramics, Artificial Iron Works.

Some of his rules for weather prediction were embodied by the U. S. Signal Service in its "Manual for Observers," and the observations of the Bureau have indicated the importance of anti-cyclonic storm centres, to which he first called attention. He claimed the discoveries of "a parabolic connection between the nearest fixed star and the solar system, of harmonic undulations which have influenced the arrangement of planets and of spectral lines, and of the quantitative equivalence of the different forms of force." He made many observations upon rainfall, and in a series of papers, "demonstrated the meteorological influence of the moon," regarding "the evidence of important lunar modifications, both in the amount and in the frequency of rain, as unmistakable."

A leading characteristic of Prof. Chase was the quiet and unwavering faith with which he adhered to the Bible record, and to Evangelical Christianity. Through all mutations, throughout his active studies of the material world, and of the great forces of Nature, he was unshaken in his belief in the spirituality of religion, and its real and necessary relation to the same Omnipotent Power, who originated the cosmos. He accepted the Christian theory of salvation absolutely and without qualification as Divine. That which many scientists are led to doubt, seemed clear to him, and all facts were of necessity parts of one stupendous whole. He was a religious man, not only by intellectual conviction ; but the fruits of piety were manifest in his daily life, especially towards its end, in an unaffected gentleness and sweetness of temper, a freedom from assumption, and a general submission of his actions to the Divine government and guidance. Wealth had few attractions for him, his tastes inclining him to count it loss if it interfered with science and religion, even if he had had any gift for accumulating, which he had not. Born in the Society of Friends, he held throughout life their belief, and of later years frequently preached to the little congregation at Radnor, of which the Haverford students and Professors formed a part. Nor was his pen idle upon religious themes, and those affecting the prosperity of the sect he loved. He read an able paper before this body on "The Philosophy of Christianity," and his lecture "On Denominational Education in the Society of Friends" was a lucid argument of much power in its favor. He was wont to press the view that God was ever acting on the soul of man to give it right direction, as well as in the phenomena of nature. His faith was not so much in doctrinal propositions, as in God himself, as revealed in Christ, in Nature, in History, and in Man's reason and conscience. But while firm in his own convictions, he was broad and charitable to others, and sought to find any ground of common truth upon which he and those who differed most widely from him could stand. His opinion was candid, and open daily, like Dr. Arnold's, to change with the advances and discoveries of science ; yet he always retained an abiding confidence that Science and Revelation would be found really to harmonize. His personal trust in a present Omnipotence enabled him to meet all the vicissitudes of fortune with a more than philosophic composure and content. While his philosophy was pervaded with religion, his religion was no less filled with philosophy, and the lustre of his life presents a shining example to those who survive him of evolution "more and more unto the perfect day," when at last the "mortal shall have put on immortality."